



## **Sampling and Analysis Plan**

### **Argonaut Mine Tailings Pile Assessment**

**Jackson, California**

**TDD No.: TO-02-09-13-01-0004  
Project No.: EE-002693-2213-01RF**

**July 2013**

**Prepared for:**

**U.S. ENVIRONMENTAL PROTECTION AGENCY  
Region 9**

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## List of Abbreviations and Acronyms

|         |   |
|---------|---|
| ACEHD   | Amador County Environmental Health Department       |
| AMRC    | Amador Metal Reductions Company                     |
| AOC     | area of concern                                     |
| ASTM    | American Society for Testing and Materials          |
| bgs     | below ground surface                                |
| BOA     | Basic Ordering Agreement                            |
| COC     | contaminant of concern                              |
| CSCC    | California Slimes Concentrating Company             |
| CVRWQCB | Central Valley Regional Water Quality Control Board |
| DQI     | Data Quality Indicator                              |
| DQO     | Data Quality Objective                              |
| DTSC    | California Department of Toxic Substances Control   |
| DU      | decision units                                      |
| E & E   | Ecology and Environment, Inc.                       |
| FOSC    | Federal On-Scene Coordinator                        |
| GPS     | Global Positioning System                           |
| IDW     | investigation-derived waste                         |
| LCS     | laboratory control sample                           |
| MCL     | Maximum Contaminant Levels                          |
| MS/MSD  | matrix spike/matrix spike duplicate                 |
| mg/kg   | milligrams per kilogram                             |
| mg/L    | milligrams per liter                                |
| µg/L    | micrograms per liter                                |

|          |  |
|----------|--|
| PAH      | Polycyclic Aromatic Hydrocarbons   |
| PM       | Project Manager  |
| PPE      | personal protective equipment  |
| QA       | quality assurance  |
| QC       | quality control  |
| RPD      | relative percent difference  |
| RSL      | Regional Screening Level   |
| r-SRL    | residential Soil Remediation Level   |
| R9 Lab   | United States Environmental Protection Agency Region 9 Richmond Laboratory |
| SAP      | Sampling and Analysis Plan   |
| SOP      | standard operating procedure   |
| sq       | square feet  |
| SRL      | Soil Remediation Level   |
| START    | Superfund Technical Assessment and Response Team                           |
| STLC     | Soluble Threshold Limit Concentration                                      |
| TAL      | Target Analyte List  |
| TDD      | Technical Direction Document   |
| TM       | Task Monitor   |
| TTLC     | Total Threshold Limit Concentration  |
| USACE    | United States Army Core of Engineers                                       |
| U.S. EPA | United States Environmental Protection Agency                              |
| XRF      | x-ray fluorescence   |
| YSI      | Yellow Springs Instruments   |



# 1 Introduction

The United States Environmental Protection Agency (U.S. EPA) Region 9 Federal On-Scene Coordinator (FOSC) Dan Shane tasked Ecology and Environment, Inc.'s (E & E's) Superfund Technical Assessment and Response Team (START) to support a time-critical assessment at the Argonaut Mine Tailings Pile site located in the City of Jackson, California (Figure 1). These assessment activities are being conducted under E & E's U.S. EPA Region 9 START Contract number EP-S5-08-01, under Technical Direction Document (TDD) number TO2-09-13-01-0004. The U.S. EPA is concerned about the Argonaut Mine Tailings Pile site based on earlier assessment reports prepared for the U.S. EPA or California Department of Toxic Substances Control (DTSC) which documented contamination from arsenic and other metals (U.S. EPA 1998a U.S. EPA 1998b, URS 2009) and outlined a removal action plan (URS 2011).

The Argonaut Mine Tailings site (the site) is comprised of approximately 64.8 acres of largely undeveloped land located in Jackson and is currently prioritized as the number two site on the Abandoned Mine Site Prioritization List for the U.S. EPA Region 9 Superfund Division. Tailings materials on the site were generated from the silver, gold, and other metal mining and ore processing that was conducted in the Jackson, California from the 1850s through the early 1940s.

Samples collected in earlier assessments indicated arsenic, lead and mercury contamination.. An 5 acre western portion of the site, area of concern 1 (AOC-1) had an average arsenic concentration of approximately 300 milligrams per kilogram (mg/kg) and a maximum concentration of 39,000 mg/kg. Arsenic, chromium, nickel, and zinc were documented as present in groundwater samples from the site at concentrations that exceeded the California Maximum Contaminant Levels (MCLs) for drinking water (URS 2011).

This document serves as the Sampling and Analysis Plan (SAP) required for the removal assessment actions at properties located at the site, and it will guide the project data collection activities. This SAP describes the project data quality objectives (DQOs), data collection rationale, quality assurance goals, and requirements for sampling and analysis. It also defines the sampling and data collection methods that will be used for this project. The scope of work outlined in this SAP is based on discussions with the U.S. EPA and the START.

The specific field sampling and chemical analysis information in this SAP was prepared in accordance with the following U.S. EPA documents: *Requirements for Quality Assurance Project Plans*, (U.S. EPA QA/R5, EPA/240/B 01/003), March 2001 (U.S. EPA, 2001); *Guidance for the Data Quality Objectives Process*, (U.S. EPA QA/G4, EPA/240/R 02/009), February 2006 (U.S. EPA, 2006); *Guidance on Choosing a Sampling Design for Environmental Data Collection*, (U.S. EPA QA/G5S, EPA/240/R 02/005) December 2002 (U.S. EPA, 2002); and, *Uniform Federal Policy for Implementing Environmental Quality System*, (EPA/505/F-03/001), March 2005 (U.S. EPA, 2005).

## 1.1 Project Organization

**U.S. EPA Federal On-Scene Coordinator (FOSC)** – The U.S. EPA FOSC will be Mr. Daniel Shane. Mr. Shane is the primary decision-maker and will direct the project, specify tasks, and ensure that the project is proceeding on schedule and is within budget. Additional duties include coordination of communication with the START Project Manager, U.S. EPA Quality Assurance (QA) Office, regulatory agencies and community residents.

**START Project Manager (PM)** – Mr. Brian Milton is the START PM. The PM manages the project's data collection efforts and is responsible for developing and implementing the SAP, coordinating project tasks and field sampling, managing field data, and completing all preliminary and final reporting.

**Principal Data Users** – Data generated by the implementation of this SAP will be utilized by the FOSC to make decisions regarding potential removal activities.

**START Quality Assurance Coordinator** – Mr. Howard Edwards is responsible for overseeing the development of this SAP. Specifically, Mr. Edwards is responsible for overseeing the documentation of project objectives and for review of the draft and final SAP document. Mr. Edwards will coordinate with the U.S. EPA's Quality Assurance Office as needed.

**Sample Analysis and Laboratory Support** – A Basic Ordering Agreement (BOA) laboratory will be used for the analysis of metals, cyanides, and other definitive analyses that cannot currently be performed by the US EPA Region 9 Richmond Laboratory (R9 Lab) due to capacity constraints. The R9 Lab will be used to prepare and analyze samples for XRF analysis.

## **1.2 Distribution List**

Copies of the final SAP will be distributed to the following persons and organizations:

- Daniel Shane, U.S. EPA Region 9
- E & E START Field Team
- E & E START project files
- Ms. Tami Trearse, DTSC
- Mr. Michael Daly, City of Jackson
- Michael Israel, Amador County
- Ross Atkinson, CVRWQCB
- Maggie Waldon, U.S. EPA Region 9 (OSC backup)
- Leslie Ramirez, U.S. EPA Region 9 (SAM)

## **1.3 Statement of the Specific Problem**

Mine tailings and ore containing elevated levels of metals exist at the site. Concentrations of arsenic, lead, and mercury above the U.S. EPA's Region 9 Regional Screening Levels for a Residential Scenario (r-RSLs) were documented in soil samples collected at the site during investigations conducted in 2008. Specifically, the westernmost portion of the site is largely devoid of plant life and has yellowish and orange stained soils. a human health risk assessment performed by URS for the site indicated an elevated health risk to even a casual trespasser (URS 2011). Soil sampling conducted in 2008 documented an average concentration of arsenic of 300 milligrams per kilogram (mg/kg) and a maximum concentration of 39,000 mg/kg in AOC-1.

Additionally, cyanides and coal tars were used in the metals extraction processes performed at the site. It is unclear if cyanides, phenols, and or polycyclic aromatic hydrocarbons (PAHs) are present in former processing areas at the site. These areas have not been adequately assessed or characterized for these compounds.

The concentrations of arsenic, chromium, nickel, and zinc in groundwater samples from the site reportedly exceeded the California Maximum Contaminant levels (MCLs) for drinking water (URS 2011).

Surface water discharges from the site are potentially contaminated with arsenic, lead, mercury and other metals and PAHs and phenols. However it is unclear if surface waters have been adequately assessed or characterized. Surface water discharging from the site flows to Jackson Creek. Jackson Creek flows into Lake Amador, a potential drinking water resource. According to the CVRWQCB, it is not currently used as a drinking water source.

The soil at the nearby residential property (Assessor's Parcel Numbers 044-071-002 and 044-071-003) just north of the site is potentially contaminated with arsenic, lead, and mercury and has also not been adequately assessed. Soils at this site are similar in appearance to those in AOC-1. According to the Amador County Environmental Health Department (ACEHD) on April 30, 2002, Geotechnical Research and Development collected two soil samples from this vacant residential property and analyzed them for arsenic by U.S. EPA Method 200.2/200.8. Arsenic was detected at concentrations of 120 mg/kg and 1,300 mg/kg. Additionally, as part of a review of a grading plan for the property that was submitted to the City of Jackson, the ACEHD used pH paper to assess drainage from the site. At the time of the on site drainage inspection, several bodies of standing water were present on the lot. All five pH measurements performed were between pH 1 and 2, indicating strongly acidic and potentially hazardous conditions (ACEHD 2003).

## 2 Site Background

### 2.1 Site Location and Description

The site is located in an alluvial valley and consists of open space characterized by soil and tailings impounded behind several berms and dams. The site is abutted by a relatively new single-family residential development (i.e. houses) to the northwest, northeast, and east, City of Jackson offices and a public high school on the west side, and open undeveloped areas on the north, south, and southeast sides. The approximate geographic coordinates for the site are Longitude 120°47'23.44"West and Latitude 38°21'26.95"North (Figure 1).

In the western portion of the site near the topographical high point there is an approximately 5-acre area of concern (AOC) of unprocessed and semi-processed ore (Figure 2). Surface impoundments may also have been present in AOC-1. This area has been designated as AOC-1 and contains localized areas of saturated sediments. East and down grade from AOC-1 is the cyanide processing plant (Cyanide Plant). This 6.5 acre area is designated as AOC-2 and contains abandoned vats and tanks reportedly used for cyanide leaching of processed ore (Figure 3). Additionally there is a thickening basin in AOC-2 associated with the cyanide plant. Extraction processes performed in this area may also have used coal tars.

AOC-3 is located southeast and down grade from AOC-2 and is a 48-acre area designated as the Tailings Disposal Area and Impoundments. There are two earthen impoundment areas in AOC-2, the Gray Sands Tailings area and the Historic Impound Basin. These impoundments were constructed to store processed tailings and to catch runoff from the tailings area. Based on borings advanced by URS, mine wastes are present to a maximum depth of approximately 80 feet bgs in AOC-3. Both dams are currently breached and surface water flows down grade to the east of AOC-3 to a 5.3 acre area containing an Eastwood-style reverse-arched concrete dam.

Surface waters discharging from the Eastwood Multiple Arch Dam (EMAD) and from other areas of the site are designated as AOC-4 (see Figure 4). The EMAD is roughly 390 feet wide and 46 feet tall. Sediment has filled the basin behind the dam to within a few feet of the top of the dam. Standing water flows over the top of the dam during wet periods. Water flows through cracks in the base of the dam, suggesting sediments behind the dam are saturated.

Roughly 300 feet north of AOC-1 is a residential lot of roughly 0.39 acre (Figure 5) that appears to have been used for storage or disposal of ore or mine tailings. This residential lot, designated as AOC-5, has yellow and orange-colored stained ground and is largely devoid of plant life.

A parcel map of the properties in the vicinity of the site is presented as Figure 6. The locations of AOC-1 through AOC-5 are also shown on Figure 6.

## **2.2 Site Geology**

Gold deposits are in a north and northwest trending mile-wide belt of gray to black slate of the Mariposa Formation (Upper Jurassic age), with some interbedded coarse and locally sheared conglomerate and minor sandy layers. Massive greenstone of the Logtown Ridge Formation (Upper Jurassic) lies west of the belt of Mariposa Formation slate. Metasedimentary rocks, chiefly graphitic schist, metachert, and amphibolite of the Calaveras Formation (Carboniferous to Permian) are to the east. Several deposits of Tertiary auriferous (gold bearing) channel gravels are exposed south of Jackson. Alluvial soils, such as Pardee cobbly loam, are found throughout the ground surface in the Jackson area (URS 2008). The ore deposits contain disseminated fine free gold, arsenopyrite (arsenic sulfide), and minor amounts of other sulfide minerals.

## **2.3 Site History**

The Argonaut Mine operated in various forms from the 1850s until 1942. The raw ore was processed at one of two stamp mills located approximately 0.5 mile north of the site and topographically upgradient from the Argonaut Mine.

In 1850 the Pioneer Mine (later known as the Argonaut Mine) was founded. It ran as a small scale operation until 1893. From 1893 until 1942 it was operated by the Argonaut Mining Company.

In 1915 an agreement was reached between mining companies, Central Valley farmers, and other interested parties in California to impound mine tailings.

In 1916 the EMAD was constructed in an alluvial canyon approximately ½-mile southeast of the Argonaut mine. The purpose of the dam was to impound tailings generated from the Argonaut mining and milling operations. This impounded area became what is now known as the Argonaut Mine Tailings Site, the current subject of this assessment.

In 1918 the California Slimes Concentrating Company (CSCC) built a cyanide plant (AOC-2) to work the tailings which were treated by Darrow concentration and cyanide vat leaching.

In 1922, the Amador Metal Reductions Company (AMRC) took over the cyanide plant from the CSCC and enlarged the plant by adding additional equipment units for processing slime and concentrate. In the cyanide plant, the mill concentrates were coated with coal tar and placed in cyanide leaching vats while slimes were treated with cyanide in an agitator. The gold-bearing solution was precipitated and then roasted.

From 1923 to 1938, after initial processing by mercury amalgamation methods at the mills located near the mine, the residual tailings (called middlings) were hydraulically transported (slurried) down gravity piping for further processing and metal extraction at the AOC-2 extraction plant. Prior to processing, middlings from the stamp mill were apparently held on site in surface impoundments (thickening basins) and/or stockpiled at AOC-1 area for further processing. The processed middlings, consisting of grey sands and fine clay-sized particles, were impounded in large ponds behind two tailings berms and the EMAD. The dam, located approximately 2,100 feet down slope of the processing plant, was positioned in a natural drainage basin at an elevation approximately 160 feet below the cyanide plant. The concrete dam has since silted in with sediments.

In 1942, the U.S. Government directed the halt of all domestic gold mining operations in favor of other metals and the Argonaut Mine and associated mills ceased operations in March of that year. Presently, approximately 1 million cubic yards of tailings remain on the site (URS 2011).

In June 1987, Biomet II leased the property from the current owner to remove ore and/or tailings from AOC-1 and transport them to Nevada for further processing. Approximately 60,000 tons of ore were transported from the site, predominantly from AOC-1. Since 1988, no further mining or business activity has taken place at the site.

## **2.4 Previous Investigations**

The California Central Valley Regional Water Quality Control Board (CVRWQCB) made DTSC aware of the site after completing surface water runoff investigations. In response, DTSC investigated the site in 1993, collected soil samples and found the soil and tailings to be impacted by arsenic and lead. The maximum arsenic level reported was approximately 24,500 mg/kg (U.S. EPA 1998). Lead was detected at concentrations up to 2,090 mg/kg and mercury up to 38 mg/kg. Water samples collected from runoff from AOC-1 reported arsenic at concentrations of 2,070 milligrams per liter (mg/l), selenium at 4.3 mg/l, copper at 40 mg/l, and nickel at 31 mg/l.

Analysis of soil samples collected in June 1993 indicated that the Site had elevated levels of arsenic, lead, and mercury. Arsenic concentrations at the Site were identified as the greatest concern. Additional soil samples were collected on 6 October 2006 and analyzed using x-ray fluorescence (XRF) techniques. The XRF analysis detected arsenic concentrations up to 7,227 mg/kg. The characterization work also indicated there were acidic soils present that could cause or contribute to acid mine drainage.

Site activities for the December 2008 investigation consisted of drilling, soil sampling, and groundwater sampling. Samples were collected from 12 soil boreholes in AOC-1 to assess the lateral and vertical extent of exposed ore. Additional samples were collected from 34 soil boreholes located in the southern portion of site. Depth-discrete groundwater samples were collected from four of the boreholes to assess impacts to groundwater. A brief summary of the results from the two areas sampled is provided below.

### AOC-1: Unprocessed/Semi-Processed Ore Pile

Arsenic concentrations exceeding 1,000 mg/kg were detected at two locations and low pH (approximately 3 to 5) surface soils were reported in this area. The lateral extent of tailings for approximately one-third of AOC-1 appears to have been defined. The lateral and vertical distribution of metal contamination (in both native soil and tailings) at concentrations exceeding residential r-RSLs were not vertically defined in most areas. However, the metal concentrations generally decreased at depth when native material/shale was encountered (roughly 20 feet bgs for AOC-1). Arsenic is the primary contaminant of concern (COC) in soil. Lead and mercury were also detected above their r-RSLs in Soil Boring SB-2 (URS 2011) and are also COCs at AOC-1. Samples from this boring also contained the highest concentrations for arsenic of any samples collected at the Site. URS estimated there are approximately 159,000 tons (e.g. 106,000 cubic yard) of soil and ore in AOC-1 containing arsenic concentrations greater than 20 mg/kg.

### AOC-2: Cyanide Processing Plant

In general, arsenic and other metal concentrations were lower in AOC-2 than in AOC-1 (URS 2011). The vertical extent of tailings appears to have been reasonably defined in AOC-2 (up to 35 feet bgs at the location of the thickening basin). The lateral extent of tailings remains undefined, particularly along the northern site boundary. Similar to AOC-1, the vertical extent of all metal concentrations generally decreases at depth when native material/shale was encountered and sampled. However, at surface locations where native material was sampled, elevated levels of arsenic were detected; suggesting tailings may have been mixed with or otherwise impacted native soils. Arsenic is considered the COC in soil in AOC-2. Lead is also considered to be a COC based on the occurrence of one sample above r-RSLs. Additionally cyanides and coal tars were used in the extraction and are potentially COCs in AOC-2.

### AOC-3 Tailings Disposal Area and Impoundments

On June 16, 1993 the California Department of Toxic Substances Control (DTSC) collected surface soil samples and had them analyzed for arsenic. Arsenic concentrations in AOC-3 ranged from 381 mg/kg at the east edge of the AOC to a maximum of 11,800 mg/kg at the west end of the AOC, near the cyanide plant.

During the URS investigation, arsenic was detected at concentrations up to 670 mg/kg and lead at concentrations up to 160 mg/kg. Additionally the DTSC tested groundwater under AOC-3 and detected arsenic up to 400 ug/L, chromium up to 130 ug/L, lead up to 24 ug/L, nickel up to 400 ug/L, and zinc up to 1,200 ug/L.

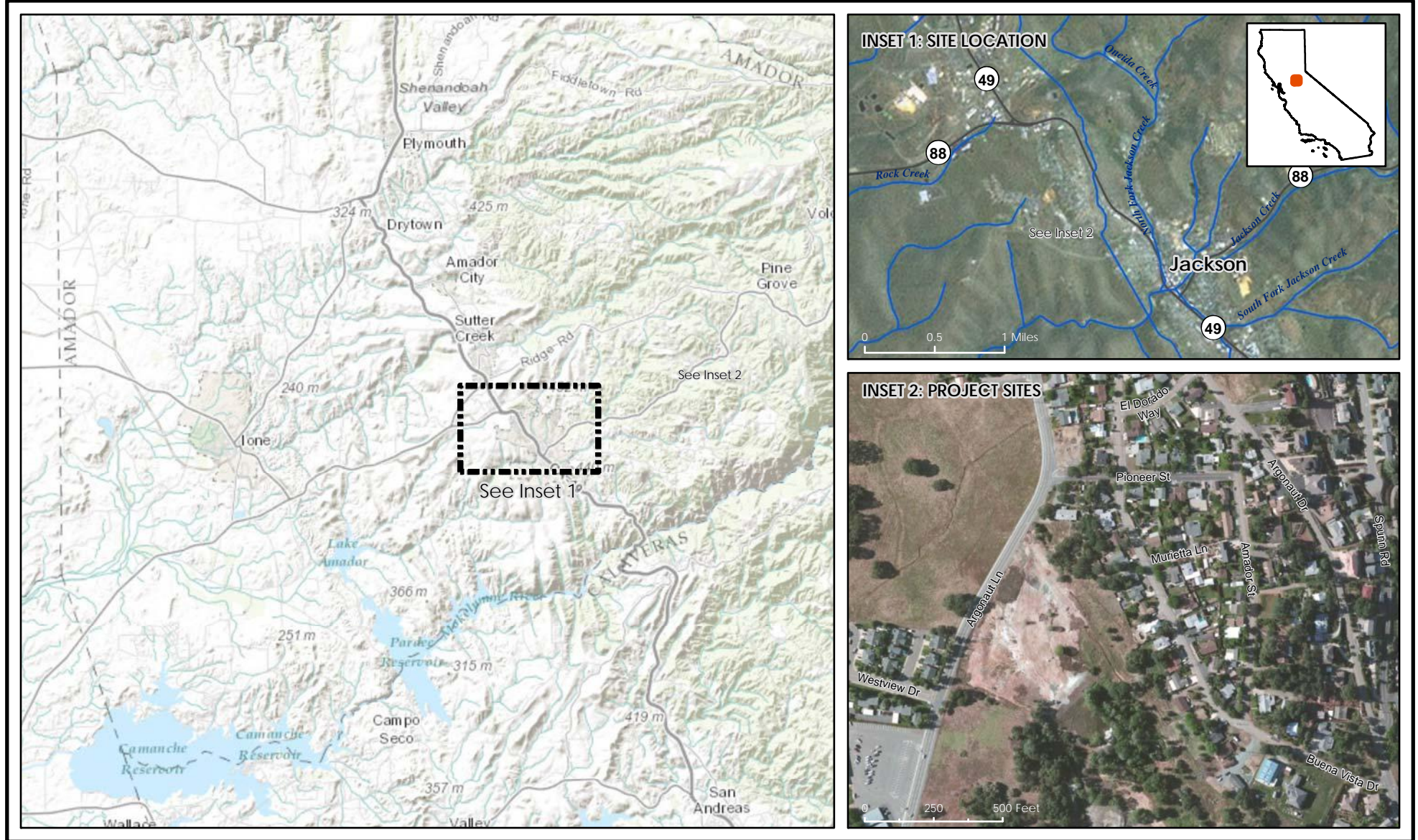
### AOC-4 Surface Water Drainage

The DTSC collected surface water samples taken on June 16, 1993 in the drainage areas on site contain arsenic levels of 2,070 mg/l adjacent to the Ore Pile, and 612 mg/l just downstream of the Cyanide Plant. Surface water samples from areas other than the drainage area did not show elevated levels of heavy metals.

### AOC-5 Residential Lot – Tailings Disposal Area

This property has been identified by the DTSC as potentially containing hazardous concentrations of toxic metals and acid generating mine wastes. On April 20, 2002 Geotechnical Research Development (GRD) collected two soil samples from AOC-5 and had them analyzed for arsenic. The arsenic values for these two samples were 120 mg/kg and 1,300 mg/kg. On February 24, 2003 the Amador County Environmental Health Department (ACEHD) sampled the runoff from the two residential lots. The ACEHD measured the pH of the stormwater runoff with pH indicator strips, all results were in the pH 1-2 range (ACEHD 2003).







# 3 Project Objectives

## 3.1 Data Use Objectives

Based on elevated arsenic, lead and mercury concentrations documented in soil samples collected during previous investigations and visual observation of staining and lack of vegetative growth, the U.S. EPA is intent on further characterizing the extent of contamination in AOC-1, including the approximate volume of soil with extremely high arsenic concentrations identified near USR soil boring SB-2.

Additionally, START will collect discrete and composite soil samples, along with discrete sediment and surface water samples in AOCs 1, 2, 4 and 5 to determine the arsenic, lead, and mercury concentrations in the surface and near surface soil. START will also sample the water and sediment in the tanks and vats in the former tailings process area for the presence of cyanide and PAHs. The U.S. EPA Site Assessment Program is expected to assess AOC-3.

The analytical data collected as part of this removal will be used to answer the following site-specific study questions:

- A. What is the lateral extent of concentrations of COCs in surface and shallow subsurface soils for AOC-1?
- B. What is the volume of soil with arsenic concentrations above approximately 1,000 mg/kg near URS soil boring SB-2.
- C. Does the water and sediment in the tanks and vats in AOC-2 contain COCs above screening levels?
- D. What is the concentration of COCs in the soil adjacent to the processing area (tanks and vats)?
- E. Are there COCs above screening levels in the surface water on site or in surface water or sediment migrating off site and are the releases impacting water quality in Jackson Creek?
- F. What is the approximate average concentrations of COCs in surface and shallow subsurface soils in the respective decision units at AOC-5?
- G. Are the leachable metals concentrations potentially above applicable hazardous waste disposal criteria for the State of California?

## 3.2 Project Task/Sampling Objectives

Site specific sampling objectives include the following:

- Determine if the average concentrations of COCs in surface soils and sediments in AOC-1, AOC-2, AOC-4, and AOC-5 are above the screening levels determined for this site.
- Determine if the leachable metals concentrations in AOC-1 and AOC-5 exceed applicable Soluble Threshold Limit Concentrations (STLC) values specified in California Code of Regulations Title 22, Chapter 11, Article 3.
- Determine if the native material adjacent to AOC-1, or other locations specified by the FOSC, are suitable vegetative cap material and what quantities are available for use in a capping removal action.
- Determine if the tanks and vats in the cyanide plant area (AOC-2) contain aqueous liquid

- or sediment with concentrations of COCs above screening levels determined for this site.
- Determine if the average concentrations of COCs in surface waters or sediment on site or discharging from the site are above screening levels determined for this site.

### **3.3 Environmental Screening Levels**

The proposed screening levels for surface soil is 61 mg/kg for arsenic, 400 mg/kg for lead, 10 mg/kg for mercury, and 22 mg/kg for cyanide. These proposed screening levels for lead and mercury are based on the Region 9 Residential Regional Screening Levels (RRSLs) (U.S. EPA May 2013). The proposed screening level for arsenic in surface soil of 61 mg/kg is based on an excess cancer risk of  $10^{-4}$ , not  $10^{-6}$  as shown in the Region 9 RRSLs.

The proposed screening levels for the surface water discharges are based upon 40 CFR 131-California Toxics Rule and CVRWQCB Water Quality Goals for Jackson Creek:

- Arsenic of 150 micrograms per liter ( $\mu\text{g/l}$ )
- Chromium - 170  $\mu\text{g/l}$
- Lead - 2.4  $\mu\text{g/l}$
- Nickel - 44  $\mu\text{g/l}$
- Mercury - 0.05  $\mu\text{g/l}$
- Zinc - 100  $\mu\text{g/l}$
- Cyanide - 5.2  $\mu\text{g/l}$

Table 3-1 presents various soil screening benchmarks and water quality standards.

### **3.4 Data Quality Objectives (DQOs)**

The DQO process, as set forth in the U.S. EPA *Guidance on Systematic Planning Using the Data Quality Objectives Process (EPA/240/B-06/001)* (U.S. EPA, 2006), was followed to establish the DQOs for this project. The DQO and the outputs for this project are included in Appendix A.

### **3.5 Data Quality Indicators (DQIs)**

Data quality indicators (DQIs) are defined as: precision, accuracy, representativeness, completeness, comparability, and method detection limits. The DQIs for this project were developed following the guidelines in the U.S. EPA *Requirements for Quality Assurance Project Plans* (U.S. EPA, 2001). Standard operating procedures will be followed to ensure representativeness and comparability of generated data. Approved U.S. EPA methods and standard reporting limits will be used. All data not rejected will be considered complete. Table 3-2 documents the site-specific DQI goals for soil, while Table 3-3 documents the DQI goals for water. Screening levels for COC Soluble STLC and Total Threshold Limit Concentrations (TTLC) are shown in Table 3-4.

### **3.6 Schedule of Sampling Activities**

The field sampling and analysis activities are scheduled to commence on or about July 9, 2013 and last up to four days. Subsequent processing and analysis of selected samples using XRF methods is scheduled to occur on July 15 and 16, 2013.

### **3.7 Special Training Requirements/Certifications**

The operation of the field analytical instruments requires specialized training that will be administered, prior to mobilization, to all START personnel scheduled to be on site.

Data validation requires specialized training and experience. Project management must determine and verify a qualified data validation resource prior to data validation.

Field sampling personnel have experience with soil sampling at hazardous waste sites while wearing appropriate protective equipment. At least one field sampler will be trained and familiar with Global Positioning System (GPS) data collection. All sampling personnel must have appropriate training that complies with 29 Code of Federal Regulations 1910.120. The site-specific health and safety plan for this project is to be appended to this plan by project management (Appendix B).

Table 3-1: Environmental Screening Levels for Metals and Cyanide<sup>(1)</sup> Argonaut Mine Site, Jackson, California

| Soil                   | ARAR   |                                   |   |   |   |
|------------------------|--|-----------------------------------|---|---|---|
| Compound               | CHHSLs Residential Soil <sup>(3)</sup> (mg/kg) | US EPA RSL <sup>(5)</sup> (mg/kg) |   | SF Bay RWQCB ESLs, Residential <sup>(7)</sup> (mg/kg) |   |
|                        |  | Carcinogenic SL                   | Non-Carcinogenic SL   | GW a Drinking Source <sup>(8)</sup>                   | GW not a Drinking Source <sup>(9)</sup> |
| Arsenic <sup>(3)</sup> | 7 <sup>(4)</sup>                               | <b>61</b> <sup>(4)</sup>          | 34  | 39  | 39                                      |
| Lead                   | 80 <sup>(6)</sup>                              | -                                 | <b>400</b>  | 8,000   | 8,000                                   |
| Mercury                | 18   | -                                 | <b>10</b>   | 670   | 670                                     |
| Cyanide                | -  | -                                 | <b>22</b>   | 0.36  | 0.36                                    |
| Surface Water          | ARAR   |                                   |   |   |   |
| Compound               | California Toxics Rule <sup>(10)</sup> (ug/L)  |                                   | Water Quality Objectives, Jackson Creek, Freshwater Aquatic Life <sup>(13)</sup> , (ug/L) |   | MCLs <sup>(14)</sup> (ug/L)             |
|                        | CCC <sup>(11)</sup>                            | CMC <sup>(11)</sup>               | CCC   | CMC   |   |
| Arsenic                | 150  | 340                               | <b>150</b>  | 340   | 200                                     |
| Chromium               | 180 (Cr III)                                   | 550                               | <b>170 (Cr-III)</b>   | 1,500 (Cr-III)  | 50                                      |
| Lead                   | 2.5  | 65                                | <b>2.4</b>  | 62  | 15                                      |
| Mercury                | <b>0.05</b> <sup>(12)</sup>                    | -                                 | -   | -   | 2                                       |
| Nickel                 | 52   | 470                               | <b>44</b>   | 390   | 100                                     |
| Zinc                   | 120  | 120                               | <b>100</b>  | 100   | 5,000                                   |
| Cyanide                | 5.2  | 22                                | <b>5.2</b>  | 22  | 15                                      |

## Notes:

- Values in bold are selected environmental screening levels.
- Background levels of arsenic are a valid ARAR. "California Environmental Protection Agency (Cal/EPA) generally does not require cleanup of soil to below background levels." Section 2.7 Substitution of Naturally Occurring Concentrations for CHHSLs. Use of California Human Health Screening Levels (CHHSLs) in Evaluation of Contaminated Properties, Cal/EPA. January 2005.
- Table 1 - California Human Health Screening Levels for Soil, Use of CHHSLs in Evaluation of Contaminated Properties, California Environmental Protection Agency. January 2005.
- U.S. EPA Superfund clean-up levels based on a Carcinogenic Target Risk of  $10^{-4}$ , the RSLs are based on a TR of  $10^{-6}$ . Values have been adjusted for a TR of  $10^{-4}$ . The arsenic value of 61 mg/kg accounts for a bioavailability factor of 60%.
- Regional Screening Level (RSL) Residential Soil Table. Region 9, U.S. EPA. May 2013.
- Table 3, Revised California Human Health Screening Levels for Lead. Integrated Risk Assessment Branch, Office of Environmental Health Hazard Assessment, California Environmental Protection Agency. September 2009.
- San Francisco Bay Regional Water Quality Control Board, Table A-1 Shallow Soil Screening Levels (<3m), Residential Land Use, May 2013. Human health values adjusted to  $10^{-4}$  (see Note 4), and corresponding lowest ESL selected.
- Table A-1. Shallow Soil Screening Levels, Residential Land Use (groundwater is a current or potential drinking water resource).
- Table B-1. Shallow Soil Screening Levels, Residential Land Use (groundwater is not a current or potential drinking water resource).
- Federal Register 40 CFR Part 131 Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California; Rule. May 18, 2000.
- CCC = Criteria Continuous Concentration (i.e. Chronic); CMC = Criteria Maximum Concentration (i.e. Acute)
- Based on Human Health  $10^{-6}$  risk for carcinogens.
- Central Valley Regional Water Quality Control Board, 31 May 2013
- Maximum Contaminant Levels. National Primary Drinking Water Regulations. U.S. EPA. May 2009.

**Table 3-2: Environmental Screening Levels for  
Polycyclic Aromatic Hydrocarbons (PAHs) Argonaut Mine Site, Jackson, California**

| <b>Compound</b>                  | <b>Soil US EPA RSL<sup>(2)</sup><br/>(mg/kg)</b> | <b>Surface Water MCL<sup>(4)</sup><br/>(ug/L)</b> |
|----------------------------------|--|---|
| Acenaphthene                     | 340  |   |
| Anthracene                       | 1,700  |   |
| Benz[a]anthracene                | 15   |   |
| Benzo(j)fluoranthene             | 38   |   |
| Benzo[a]pyrene                   | 1.5  | 0.2   |
| Benzo[b]fluoranthene             | 15   |   |
| Benzo[k]fluoranthene             | 150  |   |
| Chrysene                         | 1,500  |   |
| Dibenz[a,h]anthracene            | 1.5  |   |
| Dibenzo(a,e)pyrene               | 3.8  |   |
| Dimethylbenz(a)anthracene, 7,12- | 0.043  |   |
| Fluoranthene                     | 230  |   |
| Fluorene                         | 230  |   |
| Indeno[1,2,3-cd]pyrene           | 15   |   |
| Methylnaphthalene, 1-            | 400  |   |
| Methylnaphthalene, 2-            | 23   |   |
| Naphthalene                      | 14   |   |
| Nitropyrene, 4-                  | 38   |   |
| Pyrene                           | 170  |   |

Notes:

- 1) mg/kg = milligrams per kilogram.
- 2) ug/L = micrograms per liter.
- 3) Regional Screening Level (RSL) Resident Soil Table. Region 9, U.S. EPA. May 2013. U.S. EPA Superfund clean-up levels based on a Carcinogenic Target Risk of  $10^{-4}$ , the RSLs are based on a TR of  $10^{-6}$ . Values have been adjusted for a TR of  $10^{-4}$ .
- 4) Maximum Contaminant Levels. National Primary Drinking Water Regulations. U.S. EPA. May 2009.

### 3. Project Objectives

| <b>Table 3-3</b><br><br><b>Screening Levels and Data Quality Indicator Goals for Soil and Sediment, Definitive Data for EPA Method 6010B, Argonaut Mine Tailings Pile Assessment</b><br><br><b>TDD No: TO2-09-13-01-0004      Jackson, California      Job No: EE-002693-2213</b>          |                                 |                                      |                                  |  |                  |
|--|---------------------------------|--------------------------------------|----------------------------------|--|------------------|
| Analyte  | Project Screening Level (mg/kg) | RL for U.S. EPA Method 6010B (mg/kg) | Accuracy (% Recovery for MS/MSD) | Precision (RPD for MSD and duplicates) | Percent Complete |
| Arsenic  | 61                              | 0.002                                | 75-100                           | ≤ 35%                                  | ≥ 90             |
| Lead   | 400                             | 0.003                                | 75-100                           | ≤ 35%                                  | ≥ 90             |
| Mercury  | 10                              | 0.000025 <sup>(2)</sup>              | 75-100                           | ≤ 35%                                  | ≥ 90             |
| Cyanide  | 22                              | 0.02 <sup>(1)</sup>                  | 75-100                           | ≤ 35%                                  | ≥ 90             |
| Notes:<br>1) RL for cyanide pertains to Method 9010C<br>2) RL for mercury pertains to Method 7473.<br>MS/MSD = Matrix Spike/Matrix Spike Duplicate.<br>RL = Reporting Limit.<br>mg/kg = milligrams per kilogram.<br>RPD = Relative Percent Difference.<br>2013 ecology & environment, inc. |                                 |                                      |                                  |  |                  |

| <b>Table 3-4</b><br><br><b>Screening Levels and Data Quality Indicator Goals for Surface Water, Definitive Data for EPA Method 200.7, Argonaut Mine Tailings Pile Assessment</b><br><br><b>TDD No: TO2-09-13-01-0004      Jackson, California      Job No: EE-002693-2213</b>  |                                |                                     |                                  |  |                  |
|--|--------------------------------|-------------------------------------|----------------------------------|--|------------------|
| Analyte  | Project Screening Level (ug/L) | RL for U.S. EPA Method 200.7 (ug/L) | Accuracy (% Recovery for MS/MSD) | Precision (RPD for MSD and duplicates) | Percent Complete |
| Arsenic  | 150                            | 20                                  | 75-100                           | ≤ 35%                                  | ≥ 90             |
| Chromium   | 170                            | 10                                  | 75-100                           | ≤ 35%                                  | ≥ 90             |
| Lead   | 2.4                            | 2.0 <sup>(2)</sup>                  | 75-100                           | ≤ 35%                                  | ≥ 90             |
| Mercury  | 0.05                           | 0.03 <sup>(3)</sup>                 | 75-100                           | ≤ 35%                                  | ≥ 90             |
| Nickel   | 44                             | 10                                  | 75-100                           | ≤ 35%                                  | ≥ 90             |
| Zinc   | 100                            | 10                                  | 75-100                           | ≤ 35%                                  | ≥ 90             |
| Cyanide  | 5.2                            | 0.5 <sup>(1)</sup>                  | 75-100                           | ≤ 35%                                  | ≥ 90             |
| Notes:<br>1) RL for cyanide pertains to Method IA-1677<br>2) RL for lead pertains to Method 200.8, ICP-MS.<br>3) RL for mercury pertains to Method 245.1<br>MS/MSD = Matrix Spike/Matrix Spike Duplicate.<br>RL = Reporting Limit.<br>mg/kg = milligrams per kilogram.<br>RPD = Relative Percent Difference.<br>2013 ecology & environment, inc. |                                |                                     |                                  |  |                  |

### 3. Project Objectives

| <b>Table 3-5</b><br><b>Waste Disposal Limits, Argonaut Mine Tailings Pile Assessment</b><br><b>Jackson, California</b><br>TDD No: TQ2-09-13-01-0004      Job No: EE-002693-2213       |                                       |   |
|---|---------------------------------------|---|
| <b>Analyte</b>  | <b>STLC Regulatory Level<br/>mg/L</b> | <b>TTLC Regulatory Level<br/>mg/kg<br/>Wet Weight</b> |
| <b>Arsenic</b>  | 5.0                                   | 500   |
| <b>Chromium</b>   | 5                                     | 2,500   |
| <b>Lead</b>   | 5.0                                   | 1,000   |
| <b>Mercury</b>  | 0.2                                   | 20  |
| <b>Nickel</b>   | 20                                    | 2,000   |
| <b>Zinc</b>   | 250                                   | 5,000   |
| <b>Cyanide</b>  | -                                     | -   |
| Notes: 2013 ecology & environment, inc.<br>mg/L = milligrams per liter. mg/kg = milligrams per kilogram<br>Source is California Code of Regulations, Title 22, Chapter 11, Article 3. |                                       |   |

## 4 Sampling Rationale and Design

As discussed in previous sections of this SAP, the START reviewed available site information including historic sampling data and the U.S. EPA's objectives for the assessment to determine the specific sampling design. This information was used to determine the most effective sampling design that will meet the project objectives within the time and budget constraints.

The proposed sample strategy and analytes of concern are discussed below. The specific focus of this sampling is to further delineate COC concentration in each AOC as discussed in sections 4.2 through 4.5.

### 4.1 Selection of Decision Units

The decision units (DUs) have been designated based on a discussion between START and the FOOSC and are described below. The DUs are based primarily on historical study areas, and the further delineation of contaminants within those areas.

### 4.2 AOC-1: Unprocessed/Semi-Processed Ore Pile (Ore Pile)

AOC-1 as outlined in Figure 2 is roughly 5.0 acres. The entire AOC-1 will be considered as a single DU. The purpose of sampling AOC-1 is to:

- Confirm the results of the previous URS investigation. To confirm the URS findings, a 140 foot triangular grid has been laid out with up to twelve sample locations within the currently identified boundaries of AOC-1.
- Further delineate the lateral extent of elevated COC concentrations in AOC-1. In order to more accurately delineate the lateral boundaries, ten step-out samples in areas outside of AOC-1 will be collected. Additionally six judgmental discrete samples are going to be collected near the fence line of six residential properties bordering AOC-1.
- Provide additional definition of the hot spot identified near URS boring SB-2. Five discrete samples will be collected around the hot spot previously detected within AOC-1.
- Determine whether soluble metals concentrations may exceed their respective STLC values. Samples with total metals concentrations that exceed 10 times (10X) their associated STLC concentrations but are less than their TTLC values will be analyzed using the California Waste Extraction Test (WET) method for waste characterization purposes.

The proposed sample locations are shown in Figure 2. Samples will be collected at the 0-2 inch bgs interval and from 12-18 inches bgs. Occasionally, discrete judgmental sampling may occur at the discretion of the FOOSC based on the observed boundary of visual mine waste.

The samples will be prepared and analyzed in the field using the procedure and X-ray fluorescence (XRF) methods described in Section 6.4. The procedure will be used to save costs on the project. Furthermore, the relationship of field data to laboratory data will be evaluated prior to performing any removal or remedial action where field data may be used to support real-time decision making.

Soil samples will be analyzed for Target Analyte List (TAL) metals and pH. There are approximately thirty-three sample locations proposed in AOC-1, each having a surface and shallow soil sample, yielding a total of sixty-six samples not including QA/QC samples.



## **4. Sampling Rationale and Design**

Although not physically part of AOC-1, up to three samples of potential cap materials (soil borrow site) from the native soils at or near the site will be collected and tested for COCs and geotechnical analysis. Amador County has one potential soil borrow source 3-4 miles away. Adjacent to the western border of AOC-1 is a potential soil borrow site, and other locations may be determined in the field. It is anticipated that the removal action will need 16,000-20,000 cubic yards of cap material (URS 2011). The samples will be collected at the 0-18 inch bgs interval composited from five locations per sample. The samples will be chemically analyzed for TAL metals and pH. Up to three 5-point composite soil samples will be collected. The geotechnical samples of borrow soil will be analyzed for the following: Standard Proctor Compaction, Saturated Hydraulic Conductivity, Initial Volumetric Water Content, Dry Bulk Density, Unsaturated Hydraulic Conductivity, Particle Size, Percent Organic Content, and Direct Shear.

### **4.3 AOC-2: Cyanide Processing Plant (Cyanide Plant)**

AOC-2, the cyanide plant is roughly 6.5 acres in area as displayed in Figure 3. Currently the tanks and vats contain sediment and/or aqueous liquid, all mediums within each discrete tank or vat will be sampled. If, as expected, some vats are hydraulically connected or appear to have been used for the same process, the number of samples may be reduced. Proposed sample locations are shown in Figure 3. It was reported that the tanks and vats were used to store cyanide mixtures and/or process tailings with cyanide. Tailings were coated with 4 pounds of coal tar per ton of tailings in wood tumbling boxes. The sands were cyanided in leaching vats while the slimes were cyanided in an agitator, and then filtered. The gold bearing solution was then precipitated and roasted. However, no record of analysis for PAHs associated with the use of coal tar was encountered during the record search performed by START. Vat and tank samples will be analyzed for TAL metals, total and amenable cyanide, phenols, and PAHs.

Additionally, discrete judgmental surface and near surface soil samples will be collected within and near the cyanide plant area. Samples will be collected from the suspected locations of former thickening basins used in processing operations and or topographical low spots or drainages. The proposed sample locations are shown on Figure 3. The number and location of these samples may be adjusted in the field based on visual observation of topography and or apparent or suspected process operations. At a minimum, at least 3 samples will be collected down slope of the tank and vat processing area in topographical low spots.

Soil and sediment samples will be collected at the 0-2 inch bgs interval and from 12-18 inches bgs interval. There are up to eight sample locations in AOC-2, each having a surface and shallow soil sample, generating up to sixteen soil samples. There are seven tanks and eight vats, generating up to fifteen sediment samples. This yields a total of up to thirty one soil and sediment samples, not including QA/QC samples.

Each physically separated vat or tank and the associated down slope soils will be considered as separated DUs. Free liquid in each separated vat or tank will be field tested and sampled by START. Aqueous liquid will be field tested for pH by START. Samples of aqueous liquids from discrete vats or tanks will be collected and analyzed for TAL metals, total and amenable cyanide, PAHs, and phenols. There are up to seven tanks and eight vats, potentially yielding up to fifteen aqueous liquid samples not including QA/QC samples.

#### **4.4 AOC-3: Tailings Disposal Area and Impoundments**

AOC-3 is roughly 48 acres, bordered on the west by AOC-2 and on the east by AOC-4 (see Figure 6). The START will not collect any samples to assess AOC-3.

This area is expected to be sampled by U.S. EPA Site Assessment program under a separate sampling plan in the Fall of 2013.

#### **4.5 AOC-4: Surface Water Drainage**

AOC-4 consists of any surface water found on or discharging from the site. Water samples will be collected from both standing surface water sources and from drainage. The main focus of the sampling will be to collect samples from surface waters leaving the site to evaluate transport of COCs off site and the threat to human health or the environment. If possible, the surface water discharging from beneath the EMAD will be analyzed for the presence of PAHs and phenols to see if there are remaining environmental concerns from the use of coal tar during cyanide processing is potentially still present from past use of coal tar. If water is present, the START will also collect sediment samples along the drainage to Jackson Creek as it progresses through the site and downstream of the EMAD to help evaluate COC transport. AOC-4 includes the dam, surface water flowing through the site, water discharging from the base of the dam, and water in into the tributary to Jackson Creek.

Additionally, the START will take samples from upstream and downstream of where the site effluent enters Jackson Creek. If dry conditions are encountered and there is no release to Jackson Creek, then no samples will be collected and the U.S. EPA and the START will return to sample surface waters during wet weather conditions.

The determination of where to sample will be based upon visual observation during the sampling event. Additionally an attempt will be made to quantify the flow of surface waters flowing off-site if possible. All surface water associated with the site will be considered as a single DU.

The START will field test surface water for pH, oxidation-reduction potential, specific conductance, and temperature. Samples sent to the laboratory will be analyzed for TAL metals, PAHs, and phenols. The START will collect a total of ten surface water samples, not including QA/QC samples.

The START will collect surface sediment samples in the drainage as it progresses through the site to evaluate COC transport. The START will collect samples using a plastic or stainless steel scoop from 0-2 inches bgs. Proposed sediment sample locations are presented on Figure 4.

Selected sediment samples will be analyzed for TAL metals, total and amenable cyanide, PAHs, and phenols. The START will collect up to nine sediment samples. The exact number and location of sediment samples will be determined in the field by the FOSC based on professional judgment.

The FOSC has issued a work authorization to the Sacramento District Dam Safety Group of the United States Army Core of Engineers (USACE) to provide a Dam Safety Evaluation/Report. The first phase of the dam safety inspection will be performed on July 9, 2012. The United States Coast Guard (USCG) will have personnel on-site to assist in cutting brush to provide access to the dam structure. The START will collect undisturbed surface water samples prior to brush removal and inspection work..

#### **4.6 AOC-5: Residential Lot - Tailings Pile Disposal Area (Residential Lot)**

Based on guidance promulgated in the U.S. EPA's *EPA Lead-Contaminated Residential Sites Handbook, Final, OSWER 9285.7-50, August 2003 (Lead Handbook)*, residential lots with a total surface area greater than 5,000 square feet (sf), it is advisable that the property be divided into four quadrants of roughly equal surface area. The AOC-5 area is roughly 17,000 sf (0.39 acre) and has been divided into four DUs of roughly equal area; see Figure 5 for proposed sample locations.

Each DU will consist of a composite sample of 5 locations. The soil samples composited from the five selected locations within each decision unit will be considered representative of the soil in each AOC-5 DU. Selected locations for each aliquot will be roughly evenly spaced and prioritized based upon physical and legal accessibility. When composite samples are collected, the first sampling point will be collected from a centrally located point within each decision unit. The 4 other sample aliquots will be collected approximately 90 degrees from each other in the cardinal directions, at a point halfway between the center point and the decision unit boundary. Samples will be collected using a plastic or stainless steel scoop from 0-2 inch and a hand auger or shovel from 12-18 inches bgs.

Samples will be analyzed for TAL metals and pH. Samples with total metals concentrations between 10 times (10X) their respective STLC values and the TTLC values will also be analyzed for soluble metals. There are proposed a total of four composited sample locations in AOC-5, each having a surface and shallow soil sample, yielding a total of eight samples, not including QA/QC samples.

#### **4.7 Contaminants of Concern**

The COCs for soil are arsenic, lead, mercury, and pH. Additionally, cyanide, phenols, and PAHs are COCs for soil in the cyanide plant area (AOC-2). The COCs for water are arsenic, chromium, lead, nickel, zinc, and in AOC-2 cyanide. All soil, and non-saturated sediment, samples will be field analyzed for arsenic, lead, and mercury using the field portable XRF unit in accordance with U.S. EPA Method 6200. A minimum of 10 % of all samples analyzed using XRF methods will be sent to the Test America Laboratories in West Sacramento for analysis of the entire California list of metals by U.S. EPA Method 6010B.





- Proposed Grid Sample Locations
- Judgmental Sampling
- Optional Sample Location
- Approximate AOC-1
- Sample Grid







**Figure 2**  
**AOC-1: Proposed Sample**  
**Locations**

Argonaut Mine  
Jackson, California





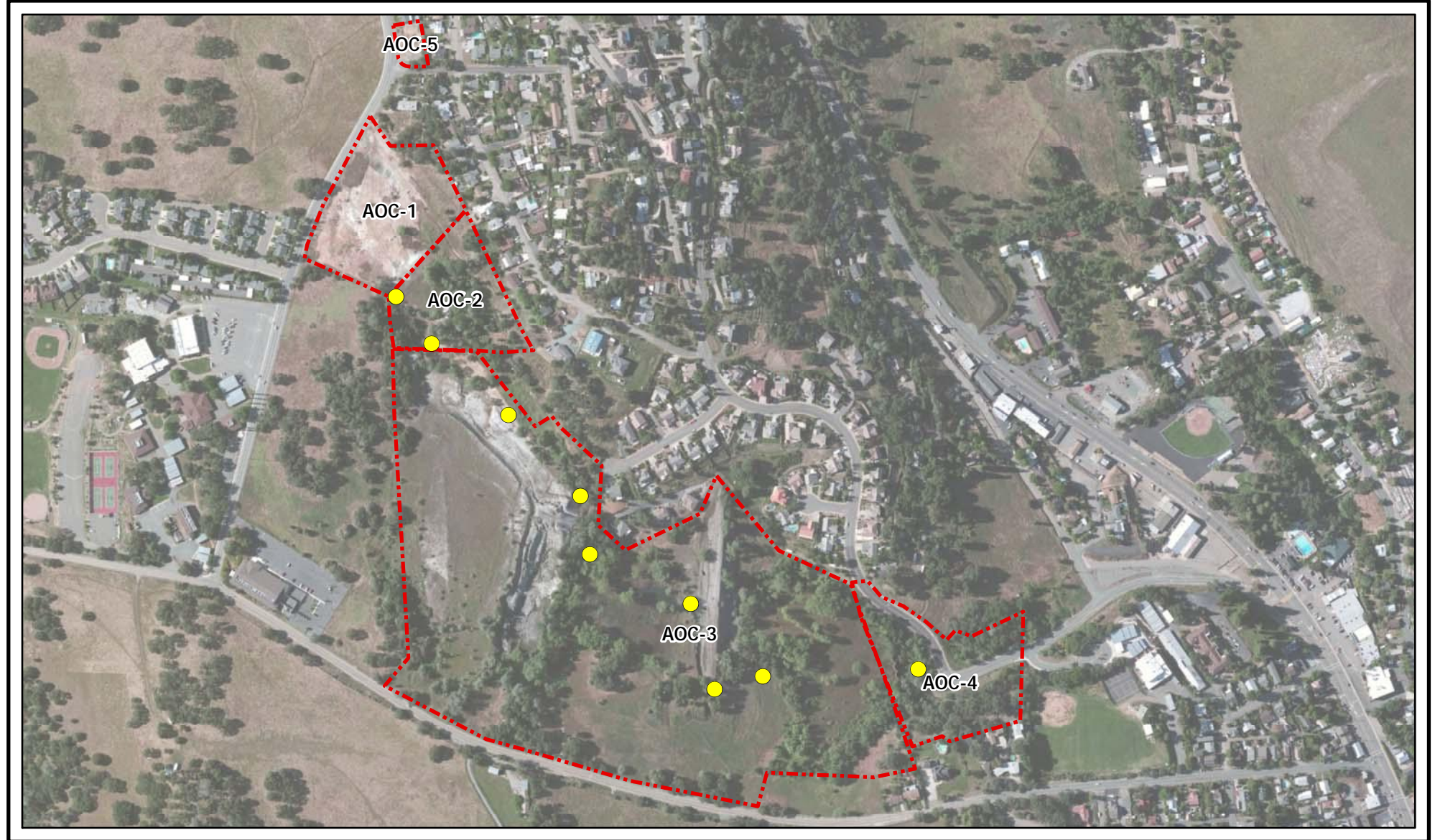
-  Proposed Thickening Basin Soil Sample Locations
-  Tank
-  Vat
-  Approximate AOC Boundary



**Figure 3**  
**AOC-2: Proposed**  
**Sample Locations**

Argonaut Mine  
Jackson, California





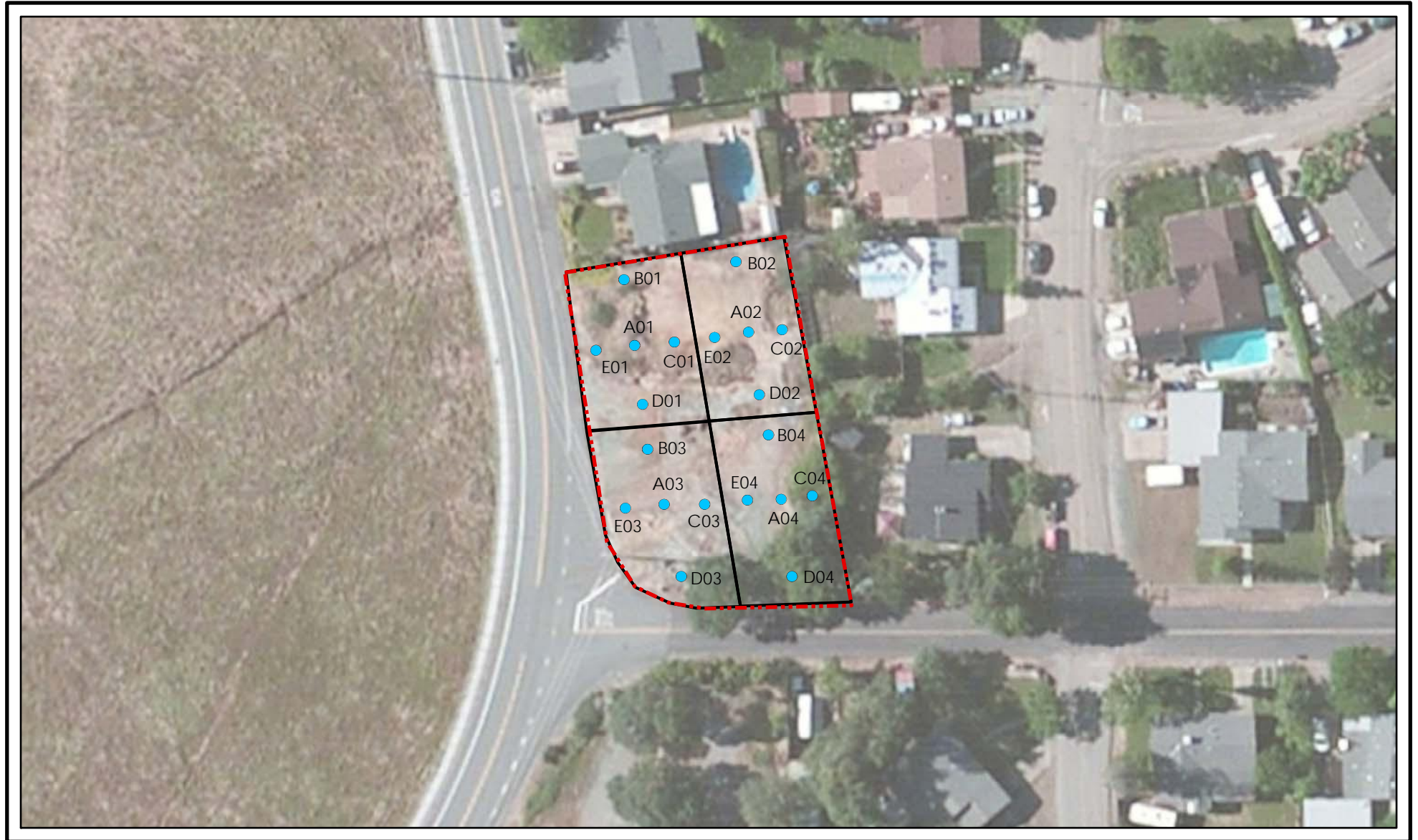
- Proposed Site Drainage Sediment Samples
- ⬡ Approximate AOC Boundary



**Figure 4**  
**AOC-4: Proposed Site**  
**Sediment Sample Locations**

Argonaut Mine  
Jackson, California





- Proposed Composite Samples
- Approximate AOC-5 Boundary
- Approximate AOC-5 Decision Unit Boundaries



**Figure 5**  
**AOC-5: Proposed**  
**Sample Locations**

Argonaut Mine  
Jackson, California





 Approximate AOC Boundary  
 Taxlots

**Figure 6**  
**Argonaut Mine Parcel Map**



Argonaut Mine  
Jackson, California



# 5 Request for Analyses

## 5.1 Field Analysis

All water samples collected will be field analyzed for pH, oxidation-reduction potential, specific conductance, and temperature.

All soil samples collected during this assessment will be analyzed in the field by START using the XRF. The manufacturer's guidance and EPA SW-846 Method 6200 (Appendix C) will be used to conduct analysis.

To provide analytical quality control for the field analytical effort, the following measures will be utilized:

- The analytical precision and sensitivity of the XRF instrument utilized for determination of arsenic and lead concentrations in site-specific samples will be identified during the initial days of field analysis.
- A minimum of 10 percent of soil samples analyzed by XRF will be submitted to the Test America Laboratories (a START BOA analytical laboratory) for confirmation analysis of arsenic and lead concentrations. At least 24 samples collected during this assessment will be submitted to the laboratory and represent the following ranges of arsenic and lead concentrations for correlation purposes: just below the ESL, just above the ESL, and high concentrations. Soil samples will be retained and additional samples will be submitted for laboratory analysis as necessary.

## 5.2 Laboratory Analysis

Soil and sediment samples (including those that require confirmation of XRF), will be submitted to Test America Laboratories (a START BOA analytical laboratory) and analyzed for TAL metals in soil (including mercury), STLC metals in soil, total and amenable cyanide in soil, soil pH, PAH, and phenols. The estimated soil sample quantities are summarized in Table 5-1. Soil analysis methods are listed in Table 5-2.

Water and aqueous liquid samples will be submitted to the U.S. EPA Region 9 Laboratory in Richmond, California, and analyzed for TAL metals, total and amenable cyanide, iron speciation, and alkalinity. Aqueous liquid and water analysis methods are listed in Tables 5-2, and 5-3 respectively.

To provide analytical quality control for the analytical program, the following measures will be utilized:

- Laboratory blind duplicate split samples will be collected from 10 percent of the sampling locations and submitted for soil analysis for both field and definitive analytical methods. A duplicate split sample is a 50/50 split of a unique sample after collection.
- For definitive EPA Method 6010B, additional sample volume will be collected for at least 5 percent of soil samples, to be utilized for matrix spike/matrix spike duplicate (MS/MSD) analysis.

## **5. Request for Analyses**

- An equipment rinsate blank will be collected by pouring distilled or de-ionized water over cleaned dedicated sampling equipment each day dedicated equipment is used. This may include trowels, hand augers, and other similar sample collection equipment.
- Test America Laboratories of West Sacramento will conduct all analyses of soil, and sediment.

Sample containers, preservatives, holding times, estimated number of initial assessment samples, and QA/QC samples for soil are summarized in Table 5-2, QA/QC samples for water are summarized in Table 5-3, and for the equipment rinsate blanks are summarized in Table 5-4.

The geotechnical analyses to determine the suitability of import cap material is not accounted for in the summary tables below, but listed as follows. The geotechnical samples will be analyzed for the following: Standard Proctor Compaction (American Society for Testing and Materials [ASTM] D698), Saturated Hydraulic Conductivity (ASTM D2434), Initial Volumetric Water Content (ASTM D2216), Dry Bulk Density (ASTM D7263-09), , Determination of Soil Water Characteristic Curve (ASTM D6836) Particle Size (ASTM D422-63), Percent Organic Content (ASTM D2974-07).. The geotechnical analysis will be performed by Daniel B. Stephens & Associates, Inc., Albuquerque, NM.

**Table 5-1 Estimated Sample Summary<sup>(1)</sup>**  
**Argonaut Mine Tailings Pile Assessment**  
**Jackson, California**

**Project No. EE-002693-2213**

**TDD No. TO-02-09-13-01-0004**

| <b>Sampling Locations</b> | <b>Aqueous Liquid and Surface Water Samples</b> | <b>Aqueous Liquid and Surface Water Field Duplicates</b> | <b>Total Water Samples Collected</b> | <b>Estimated 0-2 inch, and 12-18 inch depth Discrete Soil/Sediment Samples</b> | <b>Estimated 0-2 inch, and 12-18 inch depth Composite Soil/Sediment Samples</b> | <b>Soil or Sediment Field Duplicates</b> | <b>Unique Samples for analysis</b> | <b>Total Collected Soil Samples</b> |
|---------------------------|---|--|--------------------------------------|--|---|--|------------------------------------|-------------------------------------|
| <b>AOC-1</b>              | 0   | 0  | 0                                    | 66   | 0   | 7  | 66                                 | 73                                  |
| <b>Borrow Area</b>        | 0   | 0  | 0                                    | 0  | 4 <sup>(2)</sup>  | 1  | 3                                  | 4                                   |
| <b>AOC-2</b>              | 15  | 2  | 17                                   | 31   | 0   | 4  | 31                                 | 35                                  |
| <b>AOC-4</b>              | 10  | 1  | 11                                   | 9  |   | 1  | 9                                  | 10                                  |
| <b>AOC-5</b>              | 0   | 0  | 0                                    | 0  | 8   | 1  | 8                                  | 9                                   |
| <b>Total</b>              | <b>25</b>                                       | <b>3</b>   | <b>28</b>                            | <b>106</b>   | <b>12</b>   | <b>14</b>                                | <b>117</b>                         | <b>131</b>                          |

Notes:

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(1) Does not include any additional sampling based on field generated data or observations or aliquots analyses as described in Section 4.2.

(2) Sample from borrow area is collected between 0 and 18 inches in depth.

**Table 5-2 Estimated Soil, Sediment, and Waste Aqueous Liquid  
Analysis Summary  
Argonaut Tailings Pile Assessment  
Jackson, California**

**Project No. EE-002693-2213**

**TDD No. TO-02-09-13-01-0004**

| <b>Method</b>   | <b>Lead, Arsenic, and Mercury<br/>by XRF Field Analysis</b>   | <b>TAL<sup>(1)</sup> Metals by U.S.<br/>EPA 6010B extraction by<br/>U.S. EPA 3050B (Mercury<br/>by U.S. EPA 7471A)</b> | <b>STLC<sup>(2)</sup> Metals and<br/>Mercury by U.S.<br/>EPA 1311/1312</b> | <b>Total and<br/>Amenable Cyanide<br/>by U.S. EPA<br/>9010/9012</b> | <b>pH by<br/>U.S.<br/>EPA<br/>9045C</b> | <b>PAH and<br/>Phenols by<br/>U.S. EPA<br/>8270C</b> |
|---|---|--|--|---|---|--|
| Soil/Sediment Sample Size and Container Submitted for Preparation and Analysis        | 100 grams of soil in plastic sample bag, glass jar, or plastic jar. Sieved through a 250 micron sieve and stored in a 5-gram XRF sample cup | 100 grams of soil in plastic sample bag, glass jar or plastic jar.   | 50 grams of soil in plastic sample bag, glass jar or plastic jar.          | 4 oz glass jar for soil and sediment,                               | 4 oz glass jar.                         | 4 oz glass jar                                       |
| Waste Aqueous Liquid Sample Size and Container Submitted for Preparation and Analysis | NA  | 500 ml in plastic bottle; preserved with HNO <sub>3</sub>  | NA   | 1 L HDPE; preserved with NaOH to >12 pH                             | NA                                      | 1 L Amber glass bottle                               |
| Preservation  | 4°C <sup>(3)</sup>  | 4°C  | 4°C  | 4°C   | 4°C                                     | 4°C  |
| Analysis Holding Time   | Mercury is 28 days<br>180 days other metals   |  |  | 14 days   | asap                                    | 14 days  |
| Estimated Number of Unique Discrete Soil or Sediment Samples for Analysis             | 107   | 11   | 20   | 20  | 20                                      | 15   |
| Estimated Number of Composite Samples for Analysis                                    | 11  | 2  | 4  | 0   | 4                                       | 0  |
| Estimated Number of Aqueous Liquid Samples  | N/A   | 15   | 0  | 15  | 0                                       | 15   |
| Estimated Number of Field Duplicate Samples   | 14  | 4  | 2  | 7   | 7                                       | 3  |
| <b>Estimated Total Initial Analyses</b>   | <b>132</b>  | <b>32</b>  | <b>26</b>  | <b>42</b>   | <b>31</b>                               | <b>33</b>  |
| Matrix Spike/Matrix Spike Duplicate   | N/A   | 2  | 1  | 3   | 2                                       | 2  |

Notes:

L = liter

HDPE = high density polyethylene

(1) TAL = Target Analyte List

(2) STLC = Soluble Threshold Limit Concentration

(3) Samples will be maintained at 4°C in case the XRF vs. laboratory correlation is not valid and all samples must be sent to the laboratory for analysis.

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## 5. Request for Analyses

| <b>Table 5-3 Equipment Blank Analysis Summary</b><br><b>Argonaut Tailings Pile Assessment</b><br><b>Jackson, California</b>   |  |   |  |
|---|--|---|--|
| <b>Project No. EE-002693-2213</b>   |  | <b>TDD No. TO-02-09-13-01-0004</b>                      |  |
| <b>Method</b>   | <b>TAL<sup>(1)</sup> Metals by U.S. EPA 6010B extraction by U.S. EPA 3050B (Mercury by U.S. EPA 7471A)</b> | <b>Total and Amenable Cyanide by U.S. EPA 9010/9012</b> | <b>PAH and Phenols by U.S. EPA 8270C</b> |
| <b>Sample Type</b>  | <b>Equipment Blank</b>   | <b>Equipment Blank</b>                                  | <b>Equipment Blank</b>                   |
| Sample Container  | 500 milliliter plastic bottle  | 1 L HDPE bottle   | 1 L amber glass bottle                   |
| Preservation  | HNO <sub>3</sub> ; 4°C   | NaOH; 4°C   | 4°C                                      |
| Analysis Holding Time   | 28 days <sup>(2)</sup>   | 14 days   | 7 days                                   |
| Number of Samples   | 3  | 2   | 2  |
| Number of Field Duplicate Samples   | 0  | 0   |  |
| <b>Total Number of Samples</b>  | <b>3</b>   | <b>2</b>  | <b>2</b>                                 |
| Notes:<br>L = liter<br>PAH = Polycyclic Aromatic Hydrocarbons<br>HDPE = high density polyethylene<br>(1) TAL = Target Analyte List<br>(2) Holding time for mercury is 28 days, 180 days for all other metals. |  |   |  |

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# 6 Field Methods and Procedures

## 6.1 Field Procedures

The following sections describe the field procedures and equipment that will be used during the site activities.

### 6.1.1 Standard Operating Procedures and Equipment

The equipment listed below may be utilized to obtain environmental samples from the respective media in accordance with the following sampling standard operating procedures (SOPs) or their equivalent:

- E & E SOP No. ENV 3.08: Sediment Sampling
- E & E SOP No. ENV 3.12: Surface Water Sampling
- E & E SOP No. ENV 3.13: Soil Sampling
- E & E SOP No. ENV 3.15: Sampling Equipment Decontamination
- E & E SOP No. ENV 3.16: Sample Packaging and Shipping

Deviations from the SOPs will be documented in the field notes. SOPs are found in Appendix D. The following is a partial list of equipment that is anticipated to come in contact with samples:

- Shovels, trowels, scoops, hand auger
- Stainless steel bowls, sieves, or glass containers
- Dedicated plastic baggies and disposable trowels
- Rubber boots and waders.
- Sunscreen, bug repellent.

### 6.1.2 Equipment Maintenance

Field instrumentation for the collection of soil, sediment, and surface water samples will be operated, calibrated, and maintained by the sampling team in accordance with the SOPs listed in Section 6.1.1 or their equivalent. Field instrumentation utilized for health and safety purposes will be operated, calibrated, and maintained by the sampling team according to the manufacturer's instruction. Calibration and field use data will be recorded in the instrument log books.

### 6.1.3 Inspection/Acceptance Requirements for Supplies and Consumables

There are no project-specific inspection/acceptance criteria for supplies and consumables. It is standard operating procedure that personnel will not use broken or defective materials; items will not be used past their expiration date; supplies and consumables will be checked against order and packing slips to verify the correct items were received; and the supplier will be notified of any missing or damaged items.

**6.1.4 Logbooks**

Field logbooks will document where, when, how, and from whom any vital project information was obtained. Logbook entries will be complete and accurate enough to permit reconstruction of field activities. A separate logbook will be maintained for each project. Logbooks are bound with consecutively numbered pages. Each page will be dated and the time of entry noted in military time. All entries will be legible, written in ink, and signed by the individual making the entries. Language will be factual, objective, and free of personal opinions. The following information will be recorded, if applicable, during the collection of each sample:

- Sample location and description
- Site sketch showing sample location and estimated distances to permanent landmarks
- Sampler's name(s)
- Date and time of sample collection
- Type of sample (matrix)
- Type of sampling equipment used
- Field observations and details important to analysis or integrity of samples (rain, odors, etc.)
- Type(s) of preservative used, if any
- Field instrument reading (such as Lumex readings for health and safety purposes, etc.)
- Receiving laboratory(ies)

Several START team members will be on site performing different duties related to sample collection, processing, and analysis. A single logbook will be maintained for the sampling activities at the site. The logbook will document the information relevant to the site activity, and at a minimum will include:

- Team members and their responsibilities
- Time of activities
- Deviations from sampling plans, site safety plans, and SAP procedures
- Levels of safety protection
- Calibration information
- On-site measurement data
- Analytical data

**6.1.5 Photographs**

Photographs will be taken at representative sampling locations and at other areas of interest. They will serve to verify information entered in the field logbook. When a photograph is taken, the following information will be written in the logbook and/or will be recorded in a separate field photograph log:

- Time, date, location, and, if appropriate, weather conditions
- Description of the subject photographed
- Name of person taking the photograph

**6.1.6 Electronic Sample Logging**

The sampling team may utilize field management software to prepare sample labels and chain-of-custody forms.

The following information should be entered for each sample after collection:

- Sample name
- Sample date and time
- Number of sample bottles
- Type of preservation
- Analyses

In addition to these items, the software may also be used to keep track of other information such as sample depth, field measurements, and split samples.

The field team will generate chain-of-custody forms for each cooler of samples packaged and sent to a laboratory. Each chain-of-custody form will refer to the shipping method and tracking number. Printed chain-of-custody forms will be submitted to the laboratory with the samples.

The use of field management software may require that the field team have access to a computer, a printer, computer paper, and labels while in the field. Field team members will have received specific training in use of the software.

**6.1.7 Mapping Equipment**

Sample points will be located and documented with a GPS unit. Typically the GPS will be used to assign precise geographic coordinates to sample locations on the site. GPS mapping will be done by personnel trained in the use of the equipment and will be completed in accordance with the manufacturer's instructions. Expected output from the use of GPS mapping will be site maps with sample locations and major site features.

**6.1.8 Field Water Quality Measurements**

Water quality measurements to be performed in the field are listed in Section 4.3 and 4.5. A Yellow Springs Instrument (YSI) Model 556 MPS (multi-probe system) meter will be used to measure, pH, conductivity, temperature, and oxidation-reduction potential (ORP). The START will take measurements following instrument operation procedures as outlined in SOP 3.8, and the meter instructions. These will be recorded in the logbook for each sample location.

**6.2 Soil and Sediment Sampling Procedures**

All sample locations will be recorded in the field logbook as sampling is completed. Each field sampling team will document each individual sampling location on a field sampling sheet, which includes: the site address, area sample was collected with a quick representative sketch of the area, GPS coordinates of the AOC, photographs taken, date, time, and sampling team members. Sampling will be conducted in accordance with the E&E SOPs listed in Section 6.1. Detailed sampling procedures for soil and sediment sampling are presented below.



**6.2.1 Discrete Soil Sampling**

At each unique sample location or composite aliquot location, samples will be collected from the exposed soils at 0 to 2 inch and from 12 to 18 inches bgs. If a location is covered with grass, leaves, pine needles, or similar covering, then the grass and organic material will be removed until bare mineral soil is exposed prior to collecting the sample.

Discrete surface soil samples will be collected at the using a plastic or stainless steel scoop from 0-2 inch bgs interval and a hand auger or shovel from 12-18 inches bgs interval. Samples will be homogenized prior to placing in a jar or bag for shipment to the lab. The field sampling team will homogenize all soil samples by thoroughly mixing the collected soil. All samples will be placed in coolers on ice for storage and shipping.

The composite geotechnical samples of borrow soil will be collected in 5 gallon bucket(s) and will not be stored on ice.

**6.2.2 Sampling Sediment in Vats and Tanks**

Sediment and sludge will be sampled using a hand auger if dry, or slide hammer (or stainless steel spoon or scoop) if unable to collect with a hand auger (the exact method will depend on saturation and nature of sediment). Sediment samples will be homogenized, as practicable prior to placing in sample containers. All samples will be placed in coolers for storage and shipping to the laboratory. No confined space entries will be performed.

**6.2.3 Composite Soil Sampling**

Composite samples will be comprised of five discrete soil aliquots located with a bias to equal distribution within each sampling sector. Approximately two ounces of soil will be collected from each soil aliquot location and placed into a plastic sealable lock sampling bag; the soil will then be homogenized. A portion of each sample point to be composited will be kept separate for potential future analysis. A portion of the homogenized soil may be placed in a sample jar soil.

Composite surface samples will be collected using a hand auger or a disposable plastic trowel and will be placed in a plastic bag for homogenization. Sample containers for laboratory analysis will be closed as soon as they are filled, then chilled and processed for shipment to the laboratory. The cup and/or sample jar will be chilled pending shipment to the laboratory. All remaining sample volume will be returned to its point of origin.

**6.3 Aqueous Liquid in Tanks and Vats Sample Procedures**

Aqueous liquid sampling in tanks and vats will occur in AOC-2. AOC-2 is the cyanide plant and pH must be checked prior to sampling or sampler exposure. The sampler will lower the pH meter probe into the tank or vat while upwind of the headspace of the tank or vat. Due to the reactive nature of cyanide, if the pH of liquids in a tank or vat is in an acidic solution, samples will not be analyzed for cyanide if the pH is below 7.

Aqueous liquid samples will be collected by carefully dipping the sample container into the liquid or using a battery-operated peristaltic pump outfitted with dedicated silicone tubing. The dedicated silicone tubing will minimize the risk of cross-contamination during sample collection. The small diameter of the silicone tubing, compared to a hand dipped sample bottle, will allow liquid samples to be collected from shallow liquid with less potential to disturb and entrain the tank or vat sediment. Optionally, the sampler may collect the aqueous liquid sample with a disposable bailer.

All samples will then be placed into ice-filled coolers and kept chilled until shipped or delivered to the laboratory. A chain-of-custody record will be completed to accompany the samples to the laboratory. All samples and forms will undergo a QA review, and custody seals will be affixed to the completed sample cooler prior to shipment.

#### **6.4 Surface Water Sampling Procedures**

Surface water sampling will occur in pools of standing water, streams, and seeps. Sampling will generally begin at the farthest downstream location and proceed upstream to avoid disturbing sediments that could impact turbidity and contaminant concentrations in downstream locations. Surface water samples associated with seeps will be collected as close to the source as possible.

Water samples will be collected using a battery-operated peristaltic pump outfitted with dedicated silicone tubing or by dipping a clean polyethylene or glass container approximately halfway into the fluid column and using it to fill the appropriate sample containers. The use of dedicated silicone tubing will minimize the risk of cross-contamination during sample collection and will be the preferred method when observed water depths are less than twice the height of the largest sample container. The small diameter of the silicone tubing, compared to a hand dipped sample bottle, will allow water samples to be collected from shallow water with less potential to disturb and entrain the bed sediment. Where there is adequate depth, the water sample will be collected from a single location within the middle of the stream channel at the mid-depth water level. The silicone tubing will be held by a field team member, ensuring that the tubing is placed in the water upstream from where the field team member is standing. In the event that the stream is too large to wade, a sample will be collected from the bank in a safe location and the tubing will be placed approximately 1 foot below the surface of the water in a flowing portion of the stream.

All samples will then be placed into ice-filled coolers and kept chilled until shipped or delivered to the laboratory. A chain-of-custody record will be completed to accompany the samples to the laboratory. All samples and forms will undergo a QA review, and custody seals will be affixed to the completed sample cooler prior to shipment.

In the event that it is not possible to collect the water samples using a peristaltic pump, samples will be collected by hand-dipping the sample container directly into the creek, vat, tank, or standing pool of water. Using adequate protective clothing, the sample will be collected under the water surface by pointing the sample container upstream. The container will be upstream of the collector and care will be taken to avoid disturbing the substrate. For sample containers that have been pre-preserved, a separate pre-cleaned dedicated bottle will be used as a transfer container.

## **6. Field Methods and Procedures**

Following sample collection at each location, field parameters for pH, temperature, conductivity, oxidation-reduction potential, and dissolved oxygen, will be measured using a water-quality meter and recorded in the field logbook. At the completion of sampling each location, GPS coordinates for the sample location will be recorded.

### **6.5 Field Analytical Procedures**

Soil samples will be field analyzed by using XRF technology for total arsenic, lead, and mercury. All XRF analyses will be completed in accordance with manufacturer's guidance and the EPA Method 6200 (Appendix C). Additionally, field duplicate samples, second source control samples, and blanks will be analyzed and evaluated as quality control checks as described in Section 9.1.

Samples will be delivered to the field laboratory in heavy-duty sealable plastic bags kept at 4°C to keep mercury from volatilizing. Upon receipt the samples will be logged into the analytical logbook. Twigs, other organic matter and rocks will be removed from the samples. Samples will be homogenized while in the sample bag by kneading, crushing, and shaking the sample until mixing of the soil is complete. If the sample is saturated it will not be field analyzed but sent to the laboratory for analysis. Samples not saturated will be processed without drying the sample to preserve any mercury in the sample. The sample will then be homogenized. After homogenization, all samples will be passed through a size 250 micron sieve (#60 mesh) to remove large particles. The remaining aliquot will be transferred to a pre-labeled polyethylene cup and covered with Mylar film to be analyzed by XRF.

At the beginning of the project and prior to analysis of samples, the START will perform quality control checks including energy calibration, resolution check, background check, and a precision sample analysis. Daily quality control checks to be performed include resolution check, background check, initial calibration verification, method blank, continuing calibration verification, and an instrument blank analysis. Initial and continuing calibration verifications will be completed using standards at and below the site initial cleanup goal. Once calibrated and at the end of each set of 20 samples, a source control standard and blank will be analyzed to determine instrument performance. One out of every 10 samples will be selected for a 50/50 split duplicate. One out of every 20 samples will be selected for an analysis duplicate.

After XRF field analysis has been completed, samples selected for definitive analytical confirmation analysis will be processed for shipment to the laboratory. All samples selected for laboratory analysis will be submitted to the laboratory as the same pre-labeled polyethylene cup with Mylar film analyzed by XRF.

In addition to the cup that was analyzed using the XRF, the remaining portion of all samples selected for laboratory analysis will be transferred from the sealable holding bag to 4 or 8-ounce clean glass sample containers. Sample containers will be filled to the top, taking care to prevent soil from remaining in the threads prior to being closed to prevent potential contaminant migration to or from the sample. Sample containers will be closed as soon as they are filled, chilled, and also processed for shipment to the laboratory. The cup and sample jar will be chilled pending shipment to the laboratory. All remaining sample volume will be returned to its point of origin.

**6.6 Equipment Rinsate Blank Sampling**

Equipment decontamination rinsate water samples will be collected by pouring distilled or de-ionized water over the freshly cleaned trowel or hand auger directly into the plastic sample container. Sample containers will be filled to the top, closed as soon as they are filled, chilled and processed for shipment to the laboratory.

**6.7 Field Analytical Decontamination Procedures**

Decontamination activities will be conducted by the START in accordance with E & E SOP #3.15. All non-dedicated sample handling devices will be decontaminated according to the following procedure:

- Non-phosphate detergent and tap water wash using a brush to scrub solids from the surface
- Tap water rinse
- Triple deionized/distilled water rinse

# 7 Disposal of Investigation-Derived Waste

In the process of collecting environmental samples at this site, several different types of potentially contaminated investigation-derived wastes (IDW) will be generated, including the following:

- Used personal protective equipment (PPE)
- Disposable sampling equipment
- Decontamination fluids

The U.S. EPA's National Contingency Plan required that management of IDW generated during site investigations comply with all relevant or appropriate requirements to the extent practicable. This sampling plan will follow the Office of Emergency and Remedial Response Directive 9345.3-02 (May 1991), which provides the guidance for management of IDW during site investigations. Listed below are the procedures that will be followed for handling IDW. The procedures are flexible enough to allow the site investigation team to use its professional judgment on the proper method for the disposal of each type of IDW generated at each sampling location.

- Used PPE and disposable sampling equipment will be double bagged in plastic trash bags and disposed of in a municipal refuse dumpster. These wastes are not considered hazardous and can be sent to a municipal landfill. Any PPE or dedicated equipment that is to be disposed of that can still be reused will be rendered inoperable before disposal.
- Decontamination fluids will consist of water with residual contaminants and/or non-phosphate detergent. These fluids will be left on site to evaporate.
- Excess soils will be placed onto the hotspot on AOC-1, to be capped at a later date.



# 8 Sample Identification, Documentation and Shipment

## 8.1 Sample Nomenclature

A unique, identifiable name will be assigned to each sample. Sample nomenclature is described below and examples are provided in Table 8.1

All samples will have a prefix indicating the AOC number of the location from which they were collected.

For discrete soil samples, the prefix will be followed by a “D” indicating it is a discrete sample, then the sequential number indicating the order it was collected in, then the depth in inches. For discrete sediment samples, the prefix will be followed by a “SD” indicating it is a discrete sample, then the sequential number indicating the order it was collected in, then the depth in inches.

For composite soil samples, the prefix for each individual aliquot will be followed by a “C” indicating it’s a composite sample, then the sequential number indicating the order it was collected in, then the depth in inches. For surface soil samples taken from 0-2 inches bgs the sample depth will be “00”. For surface soil samples taken from 12-18 inches bgs the sample depth will be “12”. For individual aliquots the composite sample number will be followed by a number based on the cardinal position of the aliquot that was collected (i.e. 1-center, 2-north, 3-east, 4-south, 5-west). If a composite sediment sample is collected the prefix will be followed by an “SC”, all other composite sampling nomenclature the same as above.

AOC-5 is divided into four distinct Decision Units (DU). The DU designation will follow the AOC designation and prior to the “C” (composite) designation.

For aqueous liquid samples, the prefix for each sample will be followed by an “L” indicating it’s an aqueous liquid sample. Following the “L” designation will be the sequential number indicating the order it was collected. For surface water samples, the prefix for each sample will be followed by a “W” indicating it’s a surface water sample then the sequential number indicating the order it was collected.

Field duplicate samples will have the same designations as their originals except the sample number will be followed by a “-7”. The XRF preparation duplicate samples will have the same designations as their originals except the sample number will be followed with a “-PD”.

Equipment rinsate samples will be labeled with the last sample collected with sample equipment followed by “-EB”.

## 8. Sample Identification, Documentation and Shipment

| <b>Table 8-1 Example Sample Nomenclature</b><br><b>Argonaut Tailings Pile Assessment</b><br><b>Jackson, California</b> |                     |                                  |
|--|---------------------|----------------------------------|
| Project No. EE-002693-2213   |                     | TDD No. TO-02-09-13-01-0004      |
| Example Location   | Sample type         | Sample ID                        |
| The second soil sample location in AOC-1. Shallow subsurface soil sample collected from AOC-1 at 12 to 18 inches bgs.  | Discrete            | AOC1-D-02-12                     |
| The fourth sediment sample collected from 6 inches bgs from AOC-2.   | Discrete            | AOC2-SD-04-06                    |
| The second shallow subsurface soil sample (12-18 inch bgs) in AOC-5.   | 5-point composite   | AOC5-C-02-12                     |
| The second shallow subsurface soil sample (12-18 inch bgs) in AOC-5, east aliquot.                                     | Composite aliquot.  | AOC5-C-02-12-3                   |
| Surface soil sample (0-2 inch bgs) from DU 3 in AOC-5.   | 5-point composite   | AOC5-3-C-00                      |
| Shallow subsurface soil sample (12-18 inch bgs) from DU 3 in AOC-5.  | 5-point composite   | AOC5-3-C-12                      |
| Unique surface soil sample in AOC-5, west aliquot.   | Composite aliquot.  | AOC5-3-C-00-5                    |
| The third sediment sample collected from 6 inches bgs from AOC-2.  | Composite           | AOC2-SC-03-06                    |
| Composite aliquot of sample "AOC2-SC-03-06", west aliquot.   | Composite aliquot.  | AOC2-SC-03-06-5                  |
| Fifth liquid sample in AOC-2   | Grab                | AOC2-L-05                        |
| Seventh surface water sample in AOC-4.   | Grab                | AOC4-W-07                        |
| Field duplicate of soil sample "AOC1-D-02-12"  | Field Duplicate     | AOC1-D-02-12-7                   |
| Preparation Duplicate for U. S. EPA Method 6200 of sample "AOC1-C-02-12"   | Prep Duplicate      | AOC1-C-02-12-PD                  |
| Equipment blank taken following sample "AOC1-D-02-12".   | Equipment Duplicate | AOC1-D-02-12-EB                  |
| Notes:<br>bgs = below ground surface   |                     | 2012 ecology & environment, inc. |

### 8.2 Container, Preservation, and Holding Time Requirements

All sample containers will have been delivered to the START in a pre-cleaned condition and lab certification. Water and aqueous liquid containers will be pre-preserved according to method specifications. Preservatives (as shown in Tables 5-2 and 5-3) will be added to each sample at the time of collection. Container, preservation, and holding time requirements are summarized in Tables 5-2 and 5-3.

## **8. Sample Identification, Documentation and Shipment**

### **8.3 Sample Labeling, Packaging, and Shipping**

All samples collected will be labeled in a clear and precise way for proper identification in the field and for tracking in the laboratory. Sample labels will be affixed to the sample containers and will contain the following information:

- Sample number
- Date and time of collection
- Site name
- Analytical parameter and method of preservation

Samples will be stored in a secure location on site pending shipment to the laboratory. Sample coolers will be retained in the custody of site personnel at all times or secured so as to deny access to anyone else.

The procedures for shipping soil samples are:

- If ice is used then it will be packed in double zip-lock plastic bags.
- The drain plug of the cooler will be sealed with tape to prevent melting ice from leaking.
- The bottom of the cooler will be lined with bubble wrap to prevent breakage during shipment.
- Screw caps will be checked for tightness.
- Containers will have custody seals affixed so as to prevent opening of the container without breaking the seal.
- All glass sample containers will be wrapped in bubble wrap.
- All containers will be sealed in zip-lock plastic bags.

All samples will be placed in coolers with the appropriate chain-of-custody forms. All forms will be enclosed in plastic bags and affixed to the underside of the cooler lid. If samples require refrigeration during shipment then bags of ice will be placed on top of and around samples. Empty space in the cooler will be filled with bubble wrap or Styrofoam peanuts to prevent movement and breakage during shipment. Each ice chest will be securely taped shut with strapping tape, and custody seals will be affixed to the front, right, and back of each cooler.

## **8. Sample Identification, Documentation and Shipment**

Samples will be shipped for immediate delivery to the contracted laboratory. Upon shipping, the laboratory will be notified of:

- Sampling contractor's name.
- The name of the site.
- Shipment date and expected delivery date.
- Total number of samples, by matrix and the relative level of contamination for each sample (i.e., low, medium, or high).
- Carrier; air bill number(s), method of shipment (e.g., priority).
- Irregularities or anticipated problems associated with the samples.
- Whether additional samples will be sent; whether this is the last shipment.

### **8.4 Chain-of-Custody Forms and QA/QC Summary Forms**

A chain-of-custody form will be maintained for all samples to be submitted for analysis, from the time the sample is collected until its final disposition. Every transfer of custody must be noted and a signature affixed. Corrections on sample paperwork will be made by drawing a single line through the mistake and initialing and dating the change. The correct information will be entered above, below, or after the mistake. When samples are not under the direct control of the individual responsible for them, they must be stored in a container sealed with a custody seal. The chain-of-custody form must include the following:

- Sample identification numbers
- Identification of sample to be used for MS/MSD purposes
- Site name
- Sample date
- Number and volume of sample containers
- Required analyses
- Signature and name of samplers
- Signature(s) of any individual(s) with control over samples
- Note(s) indicating special holding times and/or detection limits

The chain-of-custody form will be completed and sent with the samples for each laboratory and each shipment. Each sample cooler should contain a chain-of-custody form for all samples within the sample cooler. Corrections on sample paperwork will be made by drawing a single line through the mistake and initialing and dating the change. The correct information will be entered above, below or after the mistake.

A QA/QC sample summary form will be completed for each method and each matrix of the sampling event. The sample number for all blanks, reference samples, laboratory QC samples (MS/MSDs), and duplicates will be documented on this form. This form is not sent to the laboratory. The original form will be sent to the reviewer who is validating and evaluating the data; a photocopy of the original will be made for the project manager master file.

# **9 Quality Assurance and Control (QA/QC)**

## **9.1 Field Quality Control Samples**

The QA/QC samples described in the following subsections, which are also partially listed in Table 5-2 and Table 5-3, will be collected during this investigation.

### **9.1.1 Equipment Blank Samples**

Equipment rinsate blanks will be collected to evaluate field sampling and decontamination procedures by pouring deionized water (for inorganic analyses) over the decontaminated sampling equipment. A minimum of one equipment rinsate blank will be collected per matrix each day that sampling equipment is decontaminated (or one per delivery group). Equipment rinsate blanks will be obtained by passing water through or over the decontaminated sampling devices used that day. The rinsate blanks collected will be analyzed for total metals. The blanks will be preserved, packaged, and sealed in a manner described in Section 8.3. A separate sample number and station number will be assigned to each blank sample, and it will be submitted blind to the laboratory.

### **9.1.2 Duplicate Samples**

Duplicate soil samples will be collected at selected sample locations. These locations will be chosen randomly in the field based on field observations and will be collected at a rate of 1 for every 10 field samples. A duplicate split sample is a 50/50 split of a sample after collection and compositing (if applicable).

### **9.1.3 Laboratory Quality Control (QC) Samples**

A laboratory QC sample, also referred to as an MS/MSD, is not an extra sample; rather, it is a sample that requires additional QC analyses and therefore may require a larger sample volume. The chain-of-custody records for these samples will identify them as laboratory QC samples. The location of laboratory QC samples will be selected at random. A minimum of one laboratory QC sample will be submitted per 20 samples (or one per delivery group), per matrix, to be analyzed for each analytical parameter. If the DQIs for analytical parameters are not achieved, further data review will be conducted to assess the impact on data quality. Laboratory QC samples, including laboratory MS/MSD and field duplicate samples, will be selected randomly.

### **9.1.4 Field Analytical Quality Control (QC) Samples**

Field analytical QC samples, also referred to as precision samples, calibration verification samples, and control standards, will be analyzed with field samples to verify and document the precision and accuracy of field analytical methods.



## **9.2 Analytical and Data Package Requirements**

It is required that all samples be analyzed in accordance with the U.S. EPA Methods listed in Table 5-2 and Table 5-3. The environmental laboratory is required to supply documentation to demonstrate that their data meet the requirements specified in the method. Data packages will not be generated for geotechnical data or for the water quality measurements made in the field. A preliminary data summary will be required 30 working days after submission of the samples for analysis. A full validation package will be required five weeks after submission of samples. The laboratory(ies) will also provide all data electronically in a Microsoft Excel-compatible format or delimited test file.

Deliverables for this project must meet the guidelines in *Laboratory Documentation Requirements for Data Evaluation* (EPA Region IX R9/QA/00.4.1, March 2001). The following deliverables are required. Note that the following data requirements are included to specify and emphasize general documentation requirements and are not intended to supersede or change requirements of each method.

- A copy of the chain-of-custody, sample log-in records, and a case narrative describing the analyses and methods used.
- Analytical data (results) for up to three significant figures for all samples, method blanks, MS/MSD, Laboratory Control Samples (LCS), duplicates, Performance Evaluation samples (if applicable), and field QC samples.
- QC summary sheets/forms that summarize the following:
  - MS/MSD/LCS recovery summary
  - Method/preparation blank summary
  - Initial and continuing calibration summary (including retention time windows)
  - Sample holding time and analytical sequence (i.e., extraction and analysis)
  - Calibration curves and correlation coefficients
  - Duplicate summary
  - Detection limit information
- Analyst bench records describing dilution, sample weight, percent moisture (solids), sample size, sample extraction and cleanup, final extract volumes, and amount injected.
- Standard preparation logs, including certificates of analysis for stock standards.
- Detailed explanation of the quantitation and identification procedure used for specific analyses, giving examples of calculations from the raw data.
- The final deliverable report consisting of sequentially numbered pages.

### **9.3 Data Management**

Samples will be collected and described in a logbook, as discussed in Section 6.1.4. Samples will be kept secure in the custody of the sampler at all times; the sampler will ensure that all preservation parameters are being followed. All samples are being submitted to an on site field laboratory for field analysis. The field analysis laboratory will document sample receipt in an analytical logbook. All samples that are to be sent to the off-site analytical laboratory will be collected and logged on chain-of-custody forms as discussed in Section 8.4. A START member will only submit samples to the analytical laboratory with chain-of-custody documentation. All submitted samples will be in a properly custody-sealed container. Specifics are discussed in Section 8.3. The laboratories will note any evidence of tampering upon receipt.

All data summary reports and complete data packages will be archived by the project manager. The data validation reports and laboratory data summary reports will be included in the final report to be submitted to the U.S. EPA.

### **9.4 Data Validation**

Data validation of environmental data will be performed by the START or their subcontractor in accordance with U.S. EPA Region IX Superfund Data Evaluation/Validation Guidance R9QA/006.1, December 2001. Data validation will not be performed on geotechnical data or water quality measurement data that was generated in the field.

The standard data quality review requirements of a Tier 2 validation of 100 percent of the data (as defined in *Requirements for Quality Assurance Project Plans*, March 2001) will satisfy the data quality requirements for this project. Upon completion of validation, data will be classified as one of the following: acceptable for use without qualifications, acceptable for use with qualifications, or unacceptable for use.

If during or after the evaluation of the project's analytical data it is found that the data contain excess QA/QC problems or if the data do not meet the DQI goals, then the independent reviewer may determine that additional data evaluation is necessary. Additional evaluation may include U.S. EPA Region IX Superfund Data Evaluation/Validation Guidance R9QA/006.1 for evaluation Tier 3.

To meet evaluation and project requirements, the following criteria will be evaluated during a Tier 2 evaluation:

- Data package completeness
- Laboratory QA/QC summaries
- Holding times
- Blank contamination
- Matrix related recoveries
- Field duplicates
- Random data checks
- Preservation and holding times
- Initial and continuing calibration

## **9. Quality Assurance and Control (QA/QC)**

- Blank analyses
- Interference check samples
- Laboratory control samples
- Duplicate sample analysis
- Matrix spike sample analyses
- Sample serial dilution
- Field duplicate/replicate
- Overall assessment of data.

Upon completion of evaluation, an analytical data evaluation Tier 2 review report will be delivered to the project manager, and the data will be classified within the report as one of the following:

- acceptable for use without qualifications
- acceptable for use with qualifications
- unacceptable for use

The data with applicable qualifications will be attached to the report. Unacceptable data may be more thoroughly examined to determine whether corrective action could mitigate data usability.

### **9.5 Field Variances**

As conditions in the field may vary, it may become necessary to implement minor modifications to this plan. When appropriate, the START QA Coordinator and U.S. EPA FOSC will be notified of the modifications and a verbal approval obtained before implementing the modifications. Modifications to the original plan will be recorded in site records and documented in the final report.

### **9.6 Assessment of Project Activities**

#### **9.6.1 Assessment Activities**

The following assessment activities will be performed by the START:

- All project deliverables (SAP, Data Summaries, Data Validation Reports, Investigation Report) will be peer reviewed prior to submission to the U.S. EPA. In time critical situations, the peer review may be concurrent with the release of a draft document to the U.S. EPA. Errors discovered in the peer review process will be reported by the reviewer to the originator of the document, who will be responsible for corrective action.
- The QA Coordinator will review project documentation (logbooks, chain-of-custody forms, etc.) to ensure the SAP was followed and that sampling activities were adequately documented. The QA Coordinator will document deficiencies, and the PM will be responsible for corrective actions.

**9.6.2 Project Status Reports to Management**

It is standard procedure for the START PM to report to the U.S. EPA Task Monitor (TM) any issues, as they occur, that arise during the course of the project that could affect data quality, data use objectives, the project objectives, or project schedules.

As requested, the START will provide XRF results to the U.S. EPA TM daily, and unvalidated data will be provided as the data are received from the laboratory.

**9.6.3 Reconciliation of Data with DQOs**

Assessment of data quality is an on-going activity throughout all phases of a project. The following outlines the methods to be used by the START for evaluating the results obtained from the project.

Review of the DQO outputs and the sampling design will be conducted by the START QA Coordinator prior to sampling activities. The reviewer will submit comments to the START PM for action, comment, or clarification. This process will be iterative.

A preliminary data review will be conducted by the START. The purpose of this review is to look for problems or anomalies in the implementation of the sample collection and analysis procedures and to examine QC data for information to verify assumptions underlying the DQOs and the SAP. When appropriate to sample design, basic statistical quantities will be calculated and the data will be graphically represented. When appropriate to the sample design and if specifically tasked to do so by the U.S. EPA TM, the START will select a statistical hypothesis test and identify assumptions underlying the test.

# 10 References

- ACEHD 2003. *Letter from R. Fourt, Registered Environmental Health Specialist with ACEHD to L. White, Chief Building Official, City of Jackson, RE: Proposed Grading and Development at Lots 30 and 31, Argonaut Heights, Jackson (APN 044-071-002 and 044-071-003).* March 4, 2003.
- California EPA 2005. *Use of California Human Health Screening Levels (CHHSLs) in Evaluation of Contaminated Properties.* January.
- California EPA 2009. *Revised California Human Health Screening Levels (CHHSLs) for Lead.* September.
- URS 2009, *Argonaut Mine Tailings Site, Site Investigation Report, Draft.* URS Corporation, March 2009.
- URS 2011, *Interim Soil Removal Action Work Plan, Argonaut Mine Tailings Site, Jackson, California, Draft Final.* URS Corporation, June 2011.
- U.S. EPA, 1998a *Remedial Site Assessment Decision, Argonaut Mine Tailings, Pioneer Mine,* EPA ID# CAD983650011, June 1998.
- U.S. EPA, 1998b, *Preliminary Assessment, Argonaut Mine Tailings (Pioneer Mine), Argonaut Lane, Hoffman Street, Jackson, Amador County, California,* October 1998.
- U.S. EPA, 1991. *Management of Investigation-Derived Wastes During Site Inspections,* Office of Emergency and Remedial Response, OERR Directive 9345.3-02, May.
- U.S. EPA, 2001. *Laboratory Documentation Requirements for Data Evaluation* (EPA Region 9 R9/QA/00.4.1), March.
- U.S. EPA, 2001. *Requirements for Quality Assurance Project Plans* (EPA QA/R 5, EPA/240/B 01/003), March.
- U.S. EPA, 2002. *Guidance on Choosing a Sampling Design for Environmental Data Collection,* (U.S. EPA QA/G5S, EPA/240/R 02/005) December.
- U.S. EPA, 2003. *Superfund Lead-Contaminated Residential Sites Handbook* (OSWER Directive 9285.7-90), August.
- U.S. EPA, 2005. *Uniform Federal Policy for Implementing Environmental Quality System,* (EPA/505/F-03/001), March.
- U.S. EPA, 2006. *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA/240/B-06/001), February.
- U.S. EPA, 2013. *Regional Screening Levels for Chemical Contaminants at Superfund Sites,* May, 2013.